RF – TEST REPORT

- FCC Part 15.247, RSS-247 -

Type / Model Name	:	SME
Product Description	:	Radio Module 802.11a/b/n/ac & BLE
Applicant	:	BSH Hausgeräte GmbH
Address	:	Carl-Wery-Straße 34 81739 München
Manufacturer	:	BSH Hausgeräte GmbH
Address	:	Carl-Wery-Straße 34 81739 München

Test Result according to the standards listed in clause 1 test standards:	**POSITIVE**

Test Report No. :	**80136616-01 Rev_0**	25. January 2023 Date of issue

Deutsche Akkreditierungsstelle
D-PL-12030-01-03
D-PL-12030-01-04

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Contents

1 TEST STANDARDS

The tests were performed according to following standards:

FCC Rules and Regulations Part 15, Subpart A - General (September 2022)

Part 15, Subpart A, Section 15.31	Measurement standards
Part 15, Subpart A, Section 15.33	Frequency range of radiated measurements
Part 15, Subpart A, Section 15.35	Measurement detector functions and bandwidths

FCC Rules and Regulations Part 15, Subpart C - Intentional Radiators (September 2022)

Part 15, Subpart C, Section 15.203	Antenna requirement
Part 15, Subpart C, Section 15.204 modifications	External radio frequency power amplifiers and antenna
Part 15, Subpart C, Section 15.205	Restricted bands of operation
Part 15, Subpart C, Section 15.207	Conducted limits
Part 15, Subpart C, Section 15.209	Radiated emission limits, general requirements
Part 15, Subpart C, Section 15.247	Operation within the bands 902 - 928 MHz, 2400 - 2483.5 MHz and 5725 - 5850 MHz

ANSI C63.10: 2013	Testing Unlicensed Wireless Devices
ETSI TR 100 028 V1.3.1: 2001-03,	Electromagnetic Compatibility and Radio Spectrum Matters (ERM); Uncertainties in the Measurement of Mobile Radio Equipment Characteristics—Part 1 and Part 2
KDB 558074 D01 v05r02	Guidance for compliance measurements on DTS; FHSS and hybrid system devices operating under Section 15.247 of the FCC rules, April 2, 2019.

2 EQUIPMENT UNDER TEST

2.1 Information provided by the Client

Please note, we do not take any responsibility for information provided by the client or his representative which may have an influence on the validity of the test results.

2.2 Sampling

The customer is responsible for the choice of sample. Sample configuration, start-up and operation is carried out by the customer or according his/her instructions.

2.3 General remarks:

This report covers the emissions of the Module "SMB" (FCC ID: 2AHES-SMB / IC: 21152-SMB) in combination with the host device SME.
Performed tests:

- AC powerline conducted emissions
- RF output power
- Transmitter unwanted emissions, radiated

2.4 Photo documentation of the EUT – Detailed photos see ATTACHMENT A

2.5 Equipment type

BLE device

2.6 Short description of the equipment under test (EUT)

The EUT is a communication module for assembling into household devices. The firmware does not support ad-hoc modes and gives the user no possibility to choose the data transmission or power setting. The EUT supports the 2.4 GHz frequency band and supports no beam forming.

Tested sample:	:	1 radiated sample
Serial number	:	800121779500004403350000000148
SW	:	BSH Embedded Linux Platform (SME default) - debug [HWTEST] 53.0.2-4-gdf59b1d
Firmware version		1.28 RC0.0 wl0: Apr 15 2021 03:04:08 version 7.45.234 (4ca95bb CY WLTEST) FWID 01-67595eaa

Tested sample:	:	1 conducted sample
Serial number	:	800121779500004403350000000071
SW	:	BSH Embedded Linux Platform (SME default) - debug [HWTEST] 53.0.2-4-gdf59b1d
Firmware version		1.28 RC0.0 wl0: Apr 15 2021 03:04:08 version 7.45.234 (4ca95bb CY WLTEST) FWID 01-67595eaa

2.7 Variants of the EUT

There are no variants.

2.8 Operation frequency and channel plan

The operating frequency is 2400 MHz to 2483.5 MHz.

Channel plan:

Channel	Frequency (MHz)	Channel	Frequency (MHz)
37	2402	18	2442
0	2404	19	2444
1	2406	20	2446
2	2408	21	2448
3	2410	22	2450
4	2412	23	2452
5	2414	24	2454
6	2416	25	2456
7	2418	26	2458
8	2420	27	2460
9	2422	28	2462
10	2424	29	2464
38	2426	30	2466
11	2428	31	2468
12	2430	32	2470
13	2432	33	2472
14	2434	34	2474
15	2436	35	2476
16	2438	36	2478
17	2440	39	2480

2.9 Transmit operating modes

The EUT uses GFSK modulation and may provide following data rates:

- 1000 kbps

(kbps = *kilobits per second)*

2.10 Antenna

The following antennas shall be used with the EUT:
The EUT has only an integrated PCB antenna, no temporary connector and no external antenna to be connected.

Number	Characteristic	Model number	Plug	Frequency range (GHz)	Gain (dBi)
1	Omni	PCB antenna (Ant0)	-	2.4	3.45
2	Omni	PCB antenna (Ant1)	-	2.4	3.30

The EUT is equipped with two internal antennas with diversity mode.
Only one antenna (Ant0) was active for testing.

For conducted tests a special prepared sample with an U.FL Port instead of Ant0 was used.

2.11 Power supply system utilised

Power supply voltage, V_{nom} : 5 V_{DC}

2.12 Peripheral devices and interface cables

The following peripheral devices and interface cables are connected during the measurements:

- USB to serial converter cable Model : -
- Laptop Model : Fujitsu (02-01/01-11-006)

2.13 Determination of worst-case conditions for final measurement

Measurements are made in all three orthogonal axes and the settings of the EUT are changed to locate at which position and at what setting of the EUT produce the maximum of the emissions.

For the final test the following channels and test modes are selected:

BLE V5	Available channel	Tested channels	Power setting	Modulation	Modulation type	Data rate
802.15.1	0 - 39	37, 39	default	DSSS	GFSK	1 Mbps

2.13.1 Test jig

No test jig is used.

2.13.2 Test software

The test software is controlled by a terminal program (PuTTY) and a set of commands. The test software allows to set the EUT into RX and TX continuous modulated mode and set different channel.

3 TEST RESULT SUMMARY

BLE device using digital modulation and operates in the 2400 MHz – 2483.5 MHz:

FCC Rule Part	RSS Rule Part	Description	Result
15.207(a)	RSS-Gen, 8.8	AC power line conducted emissions	passed
15.247(a)(2)	RSS-247, 6.2.4(1)	-6 dB EBW	Not tested [1]
15.247(b)(3)	RSS-247, 6.2.4(1)	Maximum peak conducted output power	Passed
15.247(d)	RSS-247, 6.2.4(2)	Out-of-band emission, radiated	Passed
15.247(d)	RSS-Gen, 8.9	Emissions in restricted bands	Passed
15.247(e)	RSS-247, 6.2.4(1)	PSD	Passed
15.35(c)	RSS-Gen, 6.10	Pulsed operation	Not tested [1]
15.203	RSS-Gen, 6.6	Antenna requirement	Passed
-	RSS-Gen, 6.11	Transmitter frequency stability	Not tested [1]
-	RSS-Gen, 6.6	99 % Bandwidth	Not tested [1]

[1] Not tested due to module integration requirements.

The mentioned new RSS Rule Parts in the above table are related to:
RSS-Gen, Issue 5, March 2019
RSS-247, Issue 2, February 2017

3.1 Final assessment

The equipment under test fulfills the requirements cited in clause 1 test standards.

Date of receipt of test sample : acc. to storage records

Testing commenced on : 09 September 2022

Testing concluded on : 13 October 2022

Checked by:

Klaus Gegenfurtner
2023.01.25 14:43:22
+01'00'

Klaus Gegenfurtner
Teamleader Radio

Tested by:

Lukas Scheuermann
2023.01.25 14:31:13
+01'00'

Lukas Scheuermann
Radio Team

4 TEST ENVIRONMENT

4.1 Address of the test laboratory

CSA Group Bayern GmbH
Ohmstrasse 1-4
94342 STRASSKIRCHEN
GERMANY

4.2 Environmental conditions

During the measurement the environmental conditions were within the listed ranges:

Temperature:	15 - 35 °C
Humidity:	30 - 60 %
Atmospheric pressure:	86 - 106 kPa

4.3 Statement of the measurement uncertainty

The data and results referenced in this document are true and accurate. It is noted that the expanded measurement uncertainty corresponds to the measurement results from the standard measurement uncertainty multiplied by the coverage factor k = 2. The true value is located in the corresponding interval with a probability of 95 % The measurement uncertainty was calculated for all measurements listed in this test report acc. to CISPR 16-4-2 / 2011 + A1 / 2014 „Uncertainties, statistics and limit modelling – Uncertainty in EMC measurements“ and is documented in the quality system acc. to DIN EN ISO/IEC 17025. For all measurements shown in this report, the measurement uncertainty of the test laboratory, CSA Group Bayern GmbH, is below the measurement uncertainty as defined by CISPR. Therefore, no special measures must be taken into consideration with regard to the limits according to CISPR. Furthermore, component and process variability of devices similar to that tested may result in additional deviation. The manufacturer has the sole responsibility of continued compliance of the device.

Measurement Type	Range	Confidence Level (%)	Calculated Uncertainty
AC Conducted Spurious Emissions	0.15 MHz to 30 MHz	95%	± 3.29 dB
20 dB Bandwidth	Center frequency of EUT	95%	$\pm 2.5 \times 10^{-7}$
99% Occupied Bandwidth	Center frequency of EUT	95%	$\pm 2.5 \times 10^{-7}$
Radiated Spurious Emissions	9 kHz to 30 MHz	95%	± 3.53 dB
Radiated Spurious Emissions	30 MHz to 1000 MHz	95%	± 3.71 dB
Radiated Spurious Emissions	1000 MHz to 10000 MHz	95%	± 2.34 dB
Peak conducted output power	902 MHz to 928 MHz	95%	± 0.35 dB
Conducted Spurious Emissions	9 kHz to 10000 MHz	95%	± 2.15 dB

4.4 Conformity Decision Rule

The conformity decision rule is based on the ILAC G8 published at the time of reporting.

4.5 Measurement protocol for FCC and ISED

4.5.1 General information

CSA Group Bayern GmbH is recognized as wireless testing laboratory under the CAB identifier:

FCC: DE 0011
ISED: DE0009

4.5.2 General Standard information

The test methods used comply with ANSI C63.10 - "Testing Unlicensed Wireless Devices".

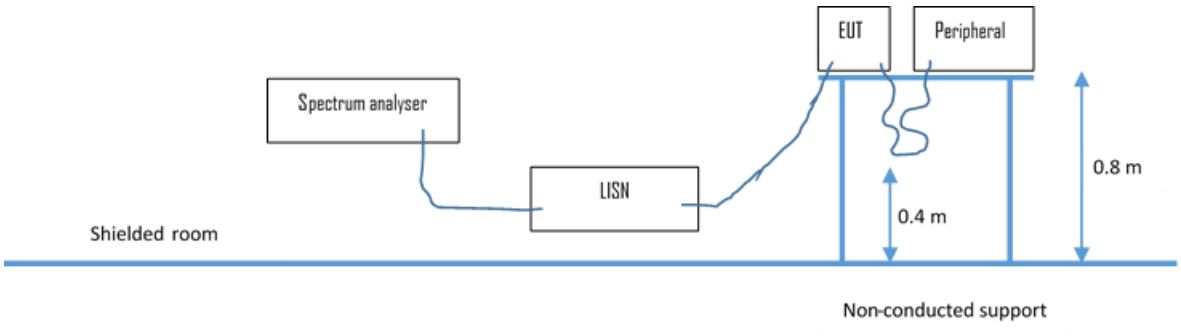
4.5.2.1 Justification

The equipment under test (EUT) is configured in a typical user arrangement in accordance with the manufacturer's instructions.

4.5.3 Details of test procedures

4.5.3.1 Conducted emission

Test setup according ANSI C63.10



The final level, expressed in dBμV, is arrived at by taking the reading directly from the Spectrum analyser. This level is compared to the limit.

To convert between dBμV and μV, the following conversions apply:

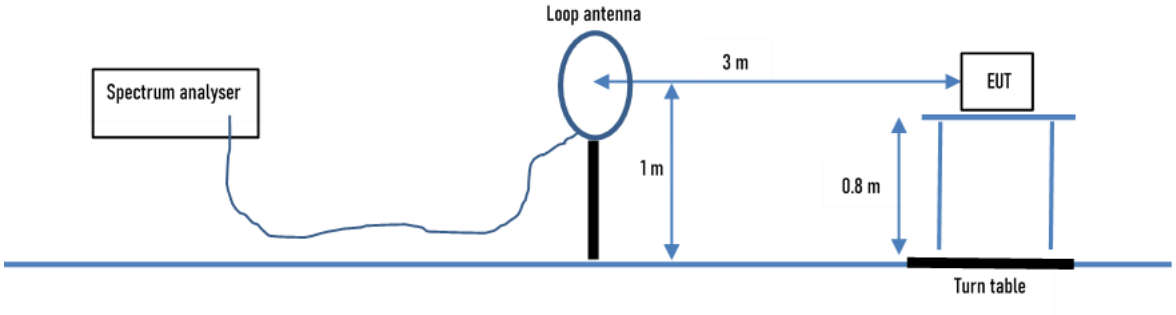
dBμV = 20(log μV)
μV = Inverse log(dBμV/20)

Conducted emissions on the 50 Hz and/or 60 Hz power interface of the EUT are measured in the frequency range of 150 kHz to 30 MHz. The measurements are performed using a receiver, which has CISPR characteristic bandwidth and quasi-peak detection and a Line Impedance Stabilization Network (LISN) with 50 Ω / 50 μH (CISPR 16) characteristics. The receiver is protected by means of an impedance matched pulse limiter connected directly to the RF input. Table top equipment is placed on a non-conducting table 80 centimetres above the floor and is positioned 40 centimetres from the vertical ground plane (wall) of the screen room. If the minimum limit margin appears to be less than 20 dB with a peak mode measurement, the emission is re-measured using a tuned receiver with quasi-peak and average detection and recorded on the data sheets.

4.5.3.2 Radiated emission

4.5.3.2.1 OATS1 test site (9 kHz - 30 MHz):

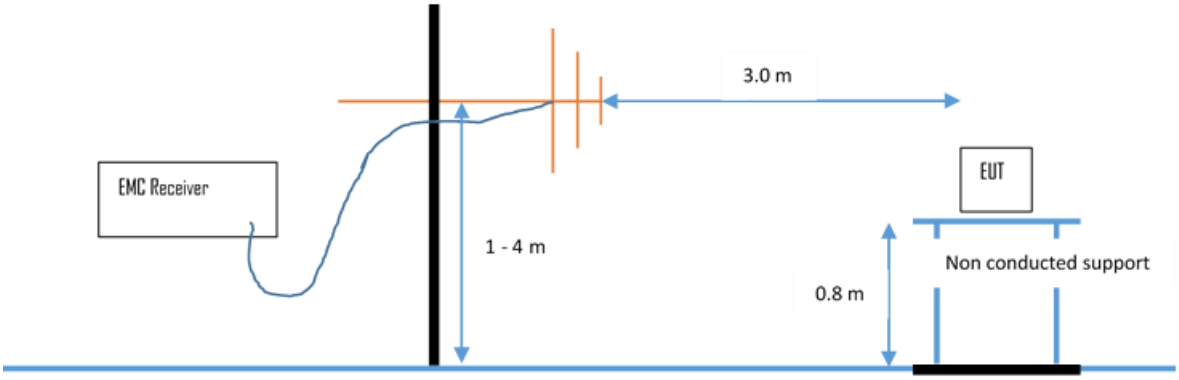
Test setup according ANSI C63.10



Emissions from the EUT are measured in the frequency range of 9 MHz to 30 MHz using a tuned receiver and a calibrated loop antenna. Table top equipment is placed on a 1.0 X 1.5 m non-conducting table 80 centimetres above the ground plane. Cables to simulators/testers (if used in this test) are routed through the center of the table and to a screened room located outside the test area. The antenna is positioned 3, 10 or 30 metres horizontally from the EUT and is repeated vertically. To locate maximum emissions from the test sample the antenna is varied along the site axis and the EUT is rotated 360 degrees.

4.5.3.2.2 OATS1 test site (30 MHz - 1 GHz):

Test setup according ANSI C63.10.



Spurious emissions from the EUT are measured in the frequency range of 30 MHz to 1000 MHz using a tuned receiver and appropriate broadband linearly polarised antennas. Measurements between 30 MHz and 1000 MHz are made with 120 kHz/6 dB bandwidth and quasi-peak detection. Table top equipment is placed on a 1.0 X 1.5 m non-conducting table 80 centimetres above the ground plane. Floor standing equipment is placed directly on the turntable/ground plane. Cables to simulators/testers (if used in this test) are routed through the center of the table and to a screened room located outside the test area. To locate maximum emissions from the test sample the antenna is varied in height from 1 to 4 metres and the EUT is rotated 360 degrees. The final level in dBµV/m is calculated by taking the reading from the EMI receiver (Level dBµV) and adding the correction factors and cable loss factor (dB). The FCC limit is subtracted from this result in order to provide the limit margin listed in the measurement protocol.

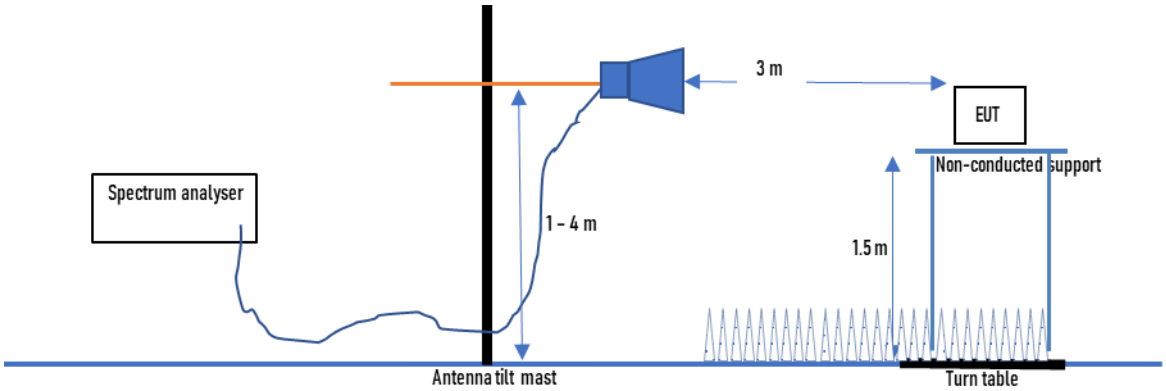
The resolution bandwidth setting:
30 MHz – 1000 MHz: RBW: 120 kHz

Example:

Frequency (MHz)	Level (dBµV)	+	Factor (dB)	=	Level (dBµV/m)	-	Limit (dBµV/m)	=	Delta (dB)
719.0	75.0	+	32.6	=	107.6	-	110.0	=	-2.4

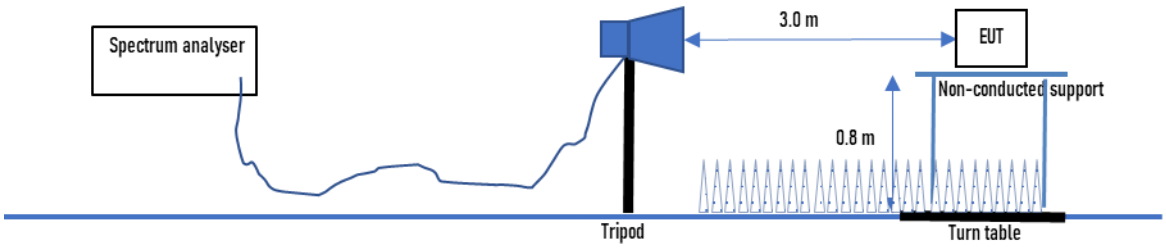
4.5.3.2.3 Anechoic chamber 1 (1000 MHz – 18000 MHz)

Test setup according ANSI C63.10.



Radiated emissions from the EUT are measured in the frequency range 1 GHz up to 18 GHz as specified in 47 CFR Part 15, Subpart A, Section 15.33, using a spectrum analyser and appropriate linearly polarized antennas. Table top equipment is placed on a non-conducting table, 1.5 metre above the ground plane. The turntable is fully covered with the appropriate absorber (Type VHP-12). Any controlling device is positioned such that it does not significantly influence the measurement results. Interconnecting cables that hang closer than 40 cm to the ground plane are folded back and forth in the centre, forming a bundle 30 cm to 40 cm long. Measurements are made in in three orientations of the EUT and the horizontal and vertical polarization planes of measurement antenna in a fully anechoic room. The measurement antenna is adjusted and the EUT orientated to permit the measurement of the maximum emission from the EUT. The conditions determined as worst-case will then be used for the final measurements.

4.5.3.2.4 Anechoic chamber 1 (18 GHz – 40 GHz)



Emissions from the EUT are measured in the frequency range 18 GHz up to 40 GHz as specified in 47 CFR Part 15, Subpart A, Section 15.33, using a spectrum analyser and appropriate linearly polarized antennas. Table top equipment is placed on a non-conducting table, 0.8 metre above the ground plane. The turntable is fully covered with the appropriate absorber (Type VHP-12). Any controlling device is positioned such that it does not significantly influence the measurement results. Interconnecting cables that hang closer than 40 cm to the ground plane are folded back and forth in the centre, forming a bundle 30 cm to 40 cm long. Measurements are made in in three orientations of the EUT and the horizontal and vertical polarization planes of measurement antenna in a fully anechoic room. The measurement antenna is adjusted and the EUT orientated to permit the measurement of the maximum emission from the EUT. The conditions determined as worst-case will then be used for the final measurements. Where appropriate, the test distance may be reduced in order to detect emissions under better uncertainty. The limit is adopted.

5 TEST CONDITIONS AND RESULTS

5.1 AC power line conducted emissions

For test instruments and accessories used see section 6 Part **A 4**.

5.1.1 Description of the test location

Test location: Shielded Room S2

5.1.2 Photo documentation of the test set-up

5.1.3 Applicable standard

According to FCC Part 15, Section 15.207(a):
Except as shown in paragraphs (b) and (c) of this Section, for an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz to 30 MHz shall not exceed the limits under FCC 15.207(a).

5.1.4 Description of Measurement

The measurements are performed following the procedures set out in ANSI C63.10 described under item 4.4.3. If the minimum limit margin appears to be less than 20 dB with a peak mode measurement, the emissions are re-measured using a tuned receiver with quasi-peak and average detection and recorded on the data sheets.

5.1.5 Test result

Frequency range: 0.15 MHz - 30 MHz

Min. limit margin -14.63 dB

Limit according to FCC Part 15, Section 15.207(a):

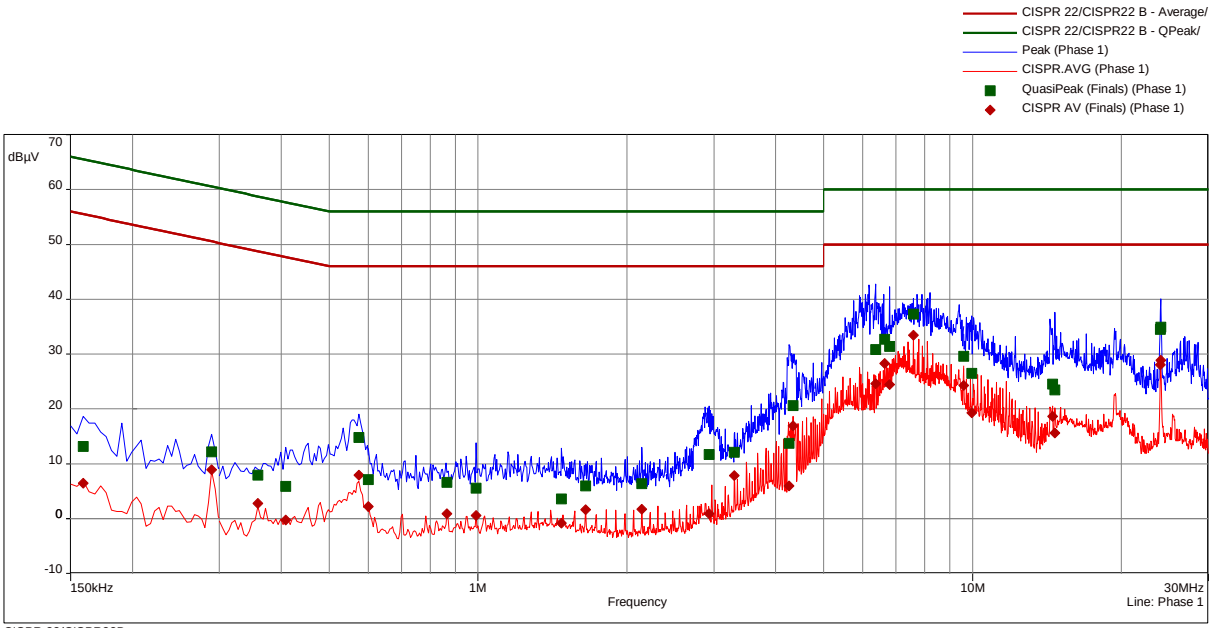
Frequency of Emission (MHz)	Conducted Limit (dBµV)	
	Quasi-peak	Average
0.15-0.5	66 to 56 *	56 to 46 *
0.5-5	56	46
5-30	60	50

* Decreases with the logarithm of the frequency

The requirements are **FULFILLED.**

Remarks: For detailed test result please refer to following test protocols.

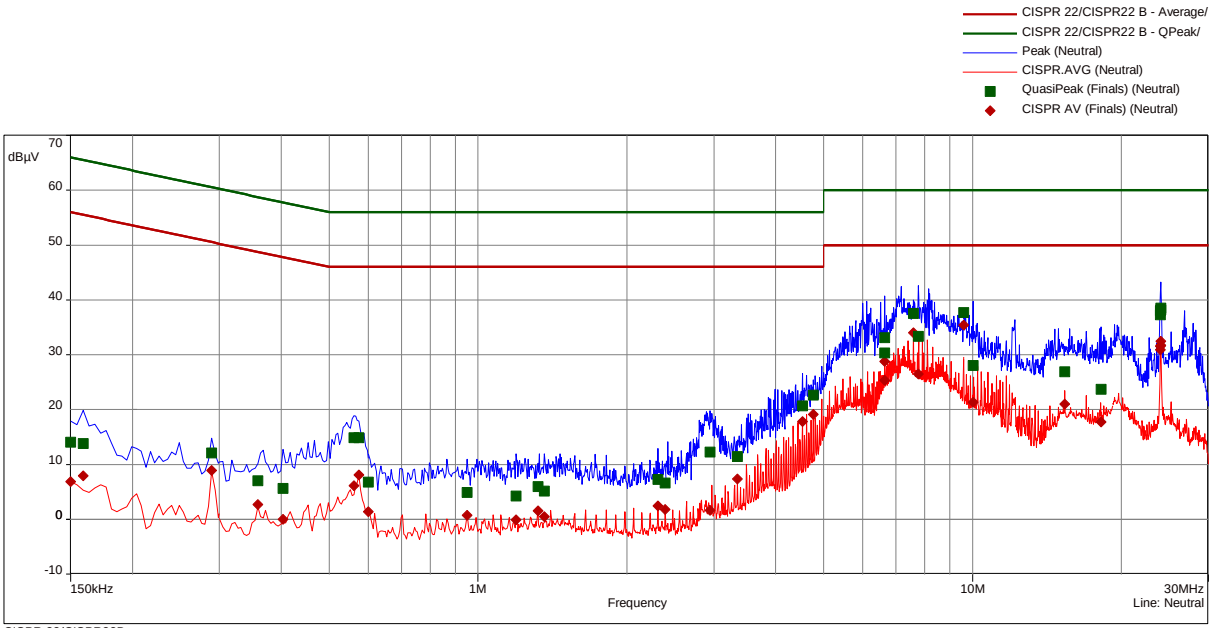
5.1.6 Test protocol



CISPR 22/CISPR22B

freq	SR	QP	margin	limit	AV	margin	limit	line	corr
MHz		dB(µV)	dB	dB	dB(µV)	dB	dB		dB
0.16	1	13.13	-52.39	65.52	6.43	-49.08	55.52	Phase 1	10.14
0.29	1	12.17	-48.37	60.54	8.91	-41.63	50.54	Phase 1	10.17
0.36	2	7.91	-50.85	58.76	2.74	-46.02	48.76	Phase 1	10.19
0.41	2	5.91	-51.78	57.69	-0.28	-47.97	47.69	Phase 1	10.20
0.57	2	14.78	-41.22	56.00	7.93	-38.07	46.00	Phase 1	10.22
0.60	3	7.12	-48.88	56.00	2.17	-43.83	46.00	Phase 1	10.22
0.87	3	6.59	-49.41	56.00	0.87	-45.13	46.00	Phase 1	10.25
0.99	3	5.54	-50.46	56.00	0.52	-45.48	46.00	Phase 1	10.26
1.47	4	3.58	-52.42	56.00	-0.83	-46.83	46.00	Phase 1	10.33
1.65	4	5.97	-50.03	56.00	1.65	-44.35	46.00	Phase 1	10.34
2.15	4	6.39	-49.61	56.00	1.72	-44.28	46.00	Phase 1	10.36
2.94	5	11.66	-44.34	56.00	0.87	-45.13	46.00	Phase 1	10.43
3.30	5	12.07	-43.93	56.00	7.83	-38.17	46.00	Phase 1	10.44
4.26	5	13.75	-42.25	56.00	5.96	-40.04	46.00	Phase 1	10.52
4.34	5	20.56	-35.44	56.00	16.94	-29.06	46.00	Phase 1	10.52
6.37	6	30.81	-29.19	60.00	24.59	-25.41	50.00	Phase 1	10.68
6.65	6	32.71	-27.29	60.00	28.31	-21.69	50.00	Phase 1	10.70
6.80	6	31.38	-28.62	60.00	24.46	-25.54	50.00	Phase 1	10.72
7.59	6	37.27	-22.73	60.00	33.48	-16.52	50.00	Phase 1	10.77
9.60	7	29.57	-30.43	60.00	24.28	-25.72	50.00	Phase 1	10.87
9.98	7	26.49	-33.51	60.00	19.31	-30.69	50.00	Phase 1	10.89
14.53	7	24.51	-35.49	60.00	18.66	-31.34	50.00	Phase 1	11.30
14.69	7	23.43	-36.57	60.00	15.62	-34.38	50.00	Phase 1	11.31
24.00	8	34.52	-25.48	60.00	28.01	-21.99	50.00	Phase 1	11.74

24.02	8	34.95	-25.05	60.00	28.87	-21.13	50.00	Phase 1	11.74



CISPR 22/CISPR22B

freq	SR	QP	margin	limit	AV	margin	limit	line	corr
MHz		dB(µV)	dB	dB	dB(µV)	dB	dB		dB
0.15	9	14.03	-51.97	66.00	6.88	-49.12	56.00	Neutral	10.14
0.16	9	13.84	-51.68	65.52	7.90	-47.62	55.52	Neutral	10.15
0.29	9	12.10	-48.43	60.54	8.88	-41.66	50.54	Neutral	10.18
0.36	10	7.02	-51.74	58.76	2.71	-46.05	48.76	Neutral	10.20
0.40	10	5.64	-52.14	57.78	-0.03	-47.82	47.78	Neutral	10.20
0.56	10	14.89	-41.11	56.00	6.15	-39.85	46.00	Neutral	10.22
0.57	10	14.84	-41.16	56.00	8.11	-37.89	46.00	Neutral	10.22
0.60	11	6.81	-49.19	56.00	1.41	-44.59	46.00	Neutral	10.22
0.95	11	4.91	-51.09	56.00	0.75	-45.25	46.00	Neutral	10.26
1.19	11	4.23	-51.77	56.00	-0.08	-46.08	46.00	Neutral	10.29
1.32	12	5.98	-50.02	56.00	1.56	-44.44	46.00	Neutral	10.31
1.36	12	5.10	-50.90	56.00	0.47	-45.53	46.00	Neutral	10.31
2.31	12	7.25	-48.75	56.00	2.41	-43.59	46.00	Neutral	10.38
2.39	12	6.63	-49.37	56.00	1.76	-44.24	46.00	Neutral	10.39
2.94	13	12.22	-43.78	56.00	1.59	-44.41	46.00	Neutral	10.43
3.35	13	11.44	-44.56	56.00	7.38	-38.62	46.00	Neutral	10.45
4.53	13	20.72	-35.28	56.00	17.83	-28.17	46.00	Neutral	10.55
4.76	13	22.63	-33.37	56.00	19.11	-26.89	46.00	Neutral	10.56
6.65	14	30.32	-29.68	60.00	25.37	-24.63	50.00	Neutral	10.74
6.65	14	33.14	-26.86	60.00	28.78	-21.22	50.00	Neutral	10.74
7.59	14	37.52	-22.48	60.00	33.99	-16.01	50.00	Neutral	10.82
7.77	14	33.39	-26.61	60.00	26.46	-23.54	50.00	Neutral	10.83
9.60	15	37.70	-22.30	60.00	35.37	-14.63	50.00	Neutral	10.95

10.04	15	28.04	-31.96	60.00	21.37	-28.63	50.00	Neutral	10.98
15.37	15	26.91	-33.09	60.00	21.01	-28.99	50.00	Neutral	11.53
18.19	15	23.67	-36.33	60.00	17.73	-32.27	50.00	Neutral	11.76
24.00	16	37.31	-22.69	60.00	30.89	-19.11	50.00	Neutral	12.05
24.00	16	38.03	-21.97	60.00	31.52	-18.48	50.00	Neutral	12.05
24.02	16	38.53	-21.47	60.00	32.45	-17.55	50.00	Neutral	12.05
24.02	16	38.19	-21.81	60.00	31.75	-18.25	50.00	Neutral	12.05

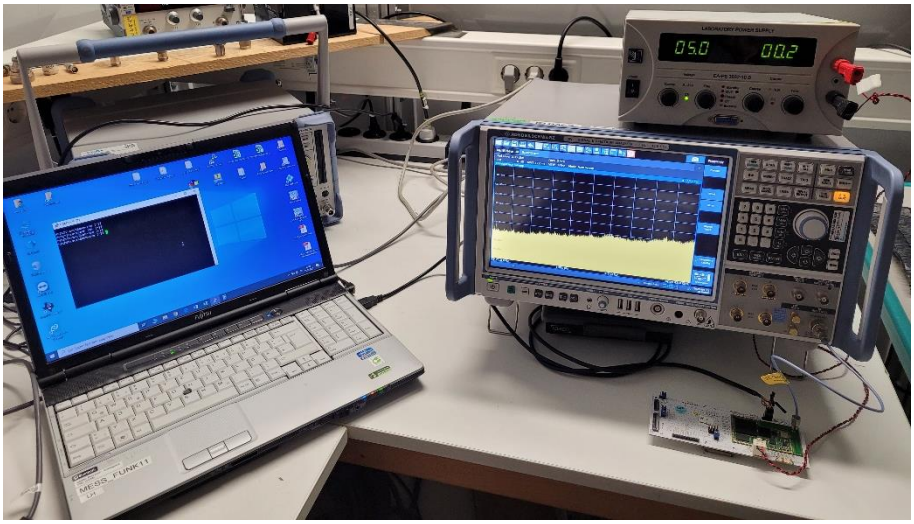
5.2 Maximum peak conducted output power

For test instruments and accessories used see section 6 Part **CPR 3**.

5.2.1 Description of the test location

Test location: Shielded Room S4

5.2.2 Photo documentation of the test set-up



5.2.3 Applicable standard

According to FCC Part 15, Section 15.247 (b)(3):
For systems using digital modulation in the 2400 – 2483.5 MHz and 5725 – 5850 MHz bands, the maximum peak output power of the transmitter shall not exceed **1 Watt**. The limit is based on transmitting antennas of directional gain that do not exceed 6 dBi.

5.2.4 Description of Measurement

The maximum peak radiated output power is measured using a spectrum analyser following the procedure set out in ANSI C63.10, item 11.9.2.2. The EUT is set in TX continuous mode while measuring. The radiated measurement was performed in terms of fieldstrength. Therefore, the formula set out in ANSI C63.10, item 9.5 (Equation 22) is changed into the following term:

$$E = EIRP - (20*\log_{10}(3)) + 104.7$$

5.2.5 Test result

Conducted Measurement					
FCC §15.247 (b)(3) | RSS-247 5.4 (d)					
Modulation	**Channel**	**Frequency**	**Measured Conducted TX Power**	**Conducted Tx-Power Limit**	**Margin**
		MHz	dBm	dBm	dB
1 Mbps	CH37	2402	2.3	30.0	-27.7
	CH17	2440	1.7	30.0	-28.3
	CH39	2480	1.5	30.0	-28.5

Radiated Peak Power Limit according to FCC Part 15, Section 15.247(b)(3):

Frequency (MHz)	Peak Power Limit	
	(dBm)	(W)
902-928	30	1.0
2400-2483.5	**30**	**1.0**
5725-5850	30	1.0

The requirements are **FULFILLED.**

Remarks: N/A

5.1 Radiated emissions in restricted bands

For test instruments and accessories used see section 6 Part **SER 2, SER 3**.

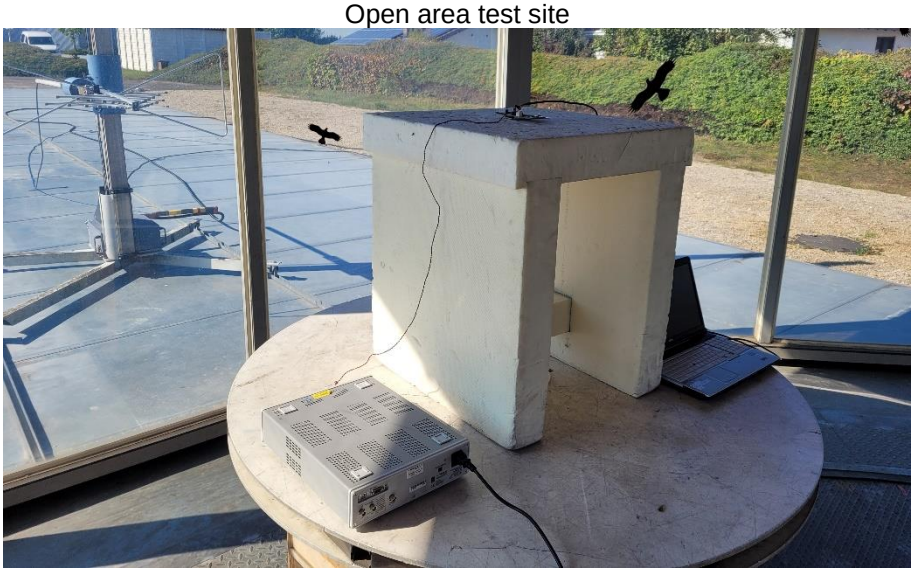
5.1.1 Description of the test location

Test location: OATS 1
Test location: Anechoic chamber 1

Test distance: 3 m

5.1.2 Photo documentation of the test set-up

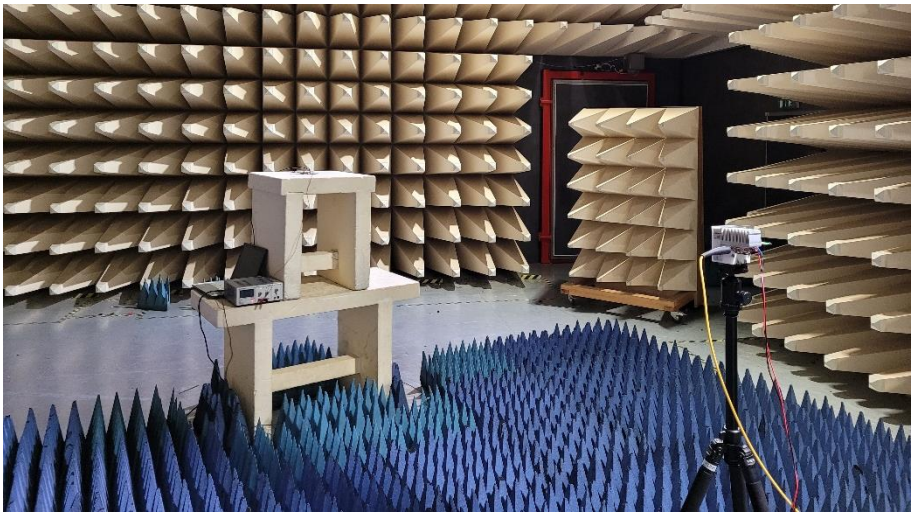
Open area test site



Anechoic chamber

Test Setup 1000 MHz < f < 18000 MHz

Test Setup f > 18000 MHz



5.1.3 Applicable standard

According to FCC Part 15, Section 15.205(a):
In addition, radiated emissions which fall in the restricted bands, as defined in Section 15.205(a), must also comply with the radiated emission limit specified in Section 15.209(a).

5.1.4 Description of Measurement

The restricted bands are measured radiated. The span of the spectrum analyser is set wide enough to capture the restricted band and measure the peak level of the emission operating on the channel closest to the band edge, as well as any modulation products which fall outside of the authorized band of operation. The restricted bands are measured falling emissions into it and the nearest restricted band are checked for emissions also the restricted band for the harmonics of the carrier.

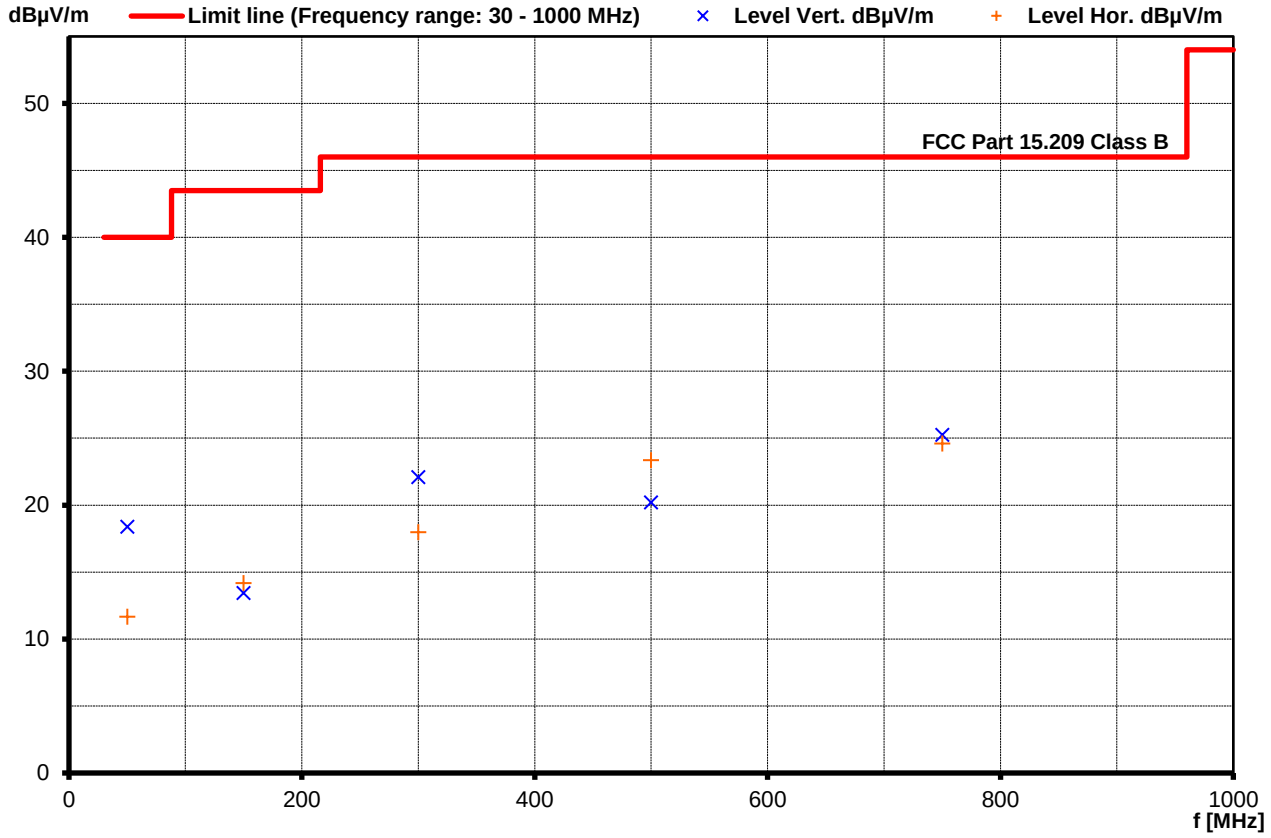
Test receiver settings for SER2:
RBW: 120 MHz, Detector: Quasi peak, Mes. Time: 1 s,

Spectrum analyser settings for SER3:
RBW: 1 MHz, VBW: 3 MHz, Detector: Max. peak, Trace: Max. hold, Sweep: Auto

5.1.5 Test result

Emissions < 1 GHz:

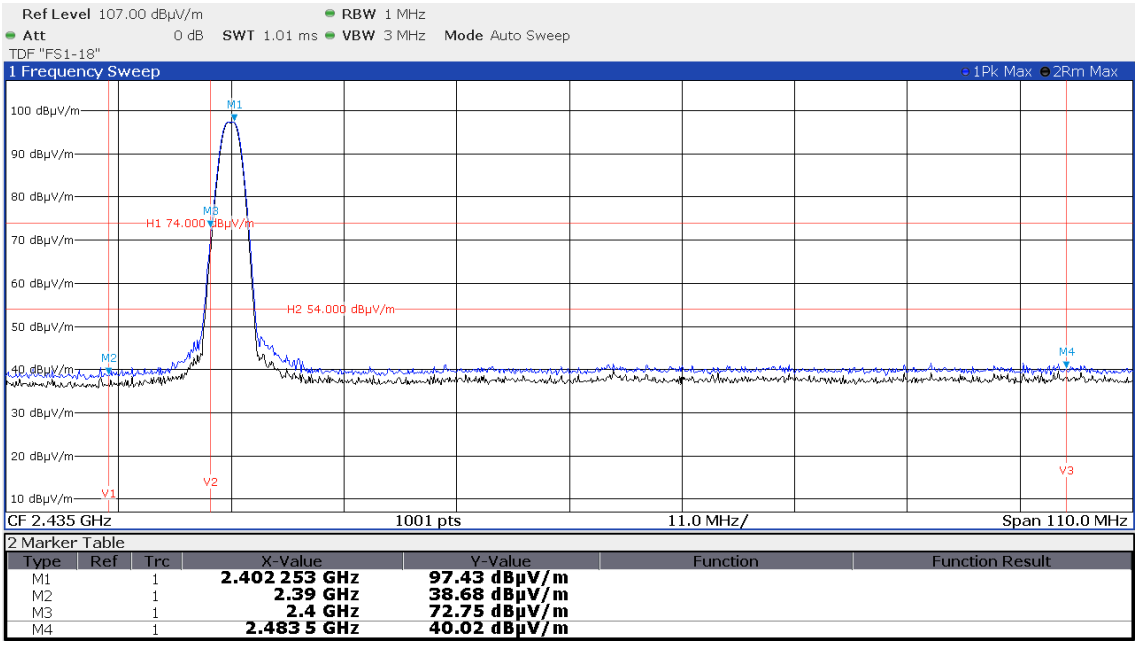
Frequency (MHz)	Reading Vert. (dBµV)	Reading Hor. (dBµV)	Correct. Vert. (dB)	Correct. Hor. (dB)	Level Vert. (dBµV/m)	Level Hor. (dBµV/m)	Limit (dBµV/m)	Dlimit (dB)
50.00	3.2	-2.5	15.2	14.2	18.4	11.7	40.0	-21.6
150.00	-0.5	-0.6	13.9	14.8	13.4	14.2	43.5	-29.3
300.00	5.2	1.5	16.9	16.5	22.1	18.0	46.0	-23.9
500.00	-2.3	1.1	22.5	22.3	20.2	23.4	46.0	-22.6
750.00	-3.0	-3.1	28.3	27.7	25.3	24.6	46.0	-20.7



Note: No emission could be identified in any operation mode. Only noise values from the OATS are recorded. Due to the small physical diamensions of the EUT no emissions 9 kHz - 30 MHz are measured.

Detailed band-edges, BLE 1 Mbps:

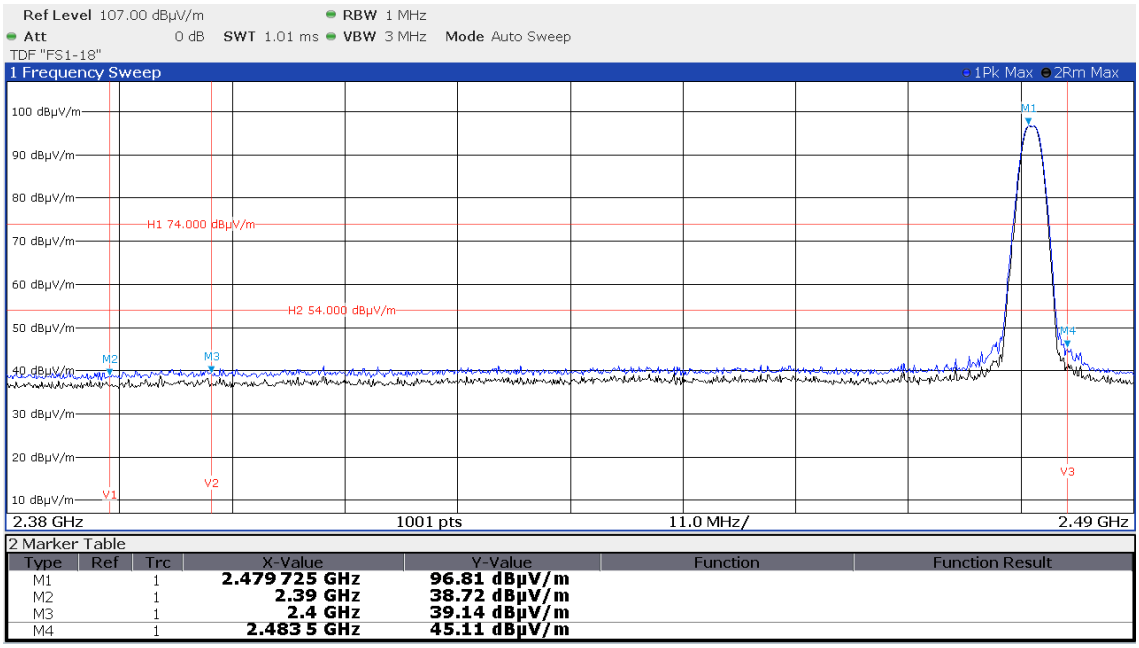
CH37:



2 Marker Table

Type	Ref	Trc	X-Value	Y-Value	Function	Function Result
M1		1	2.402 253 GHz	97.43 dBµV/m		
M2		1	2.39 GHz	38.68 dBµV/m		
M3		1	2.4 GHz	72.75 dBµV/m		
M4		1	2.483 5 GHz	40.02 dBµV/m		

CH39:

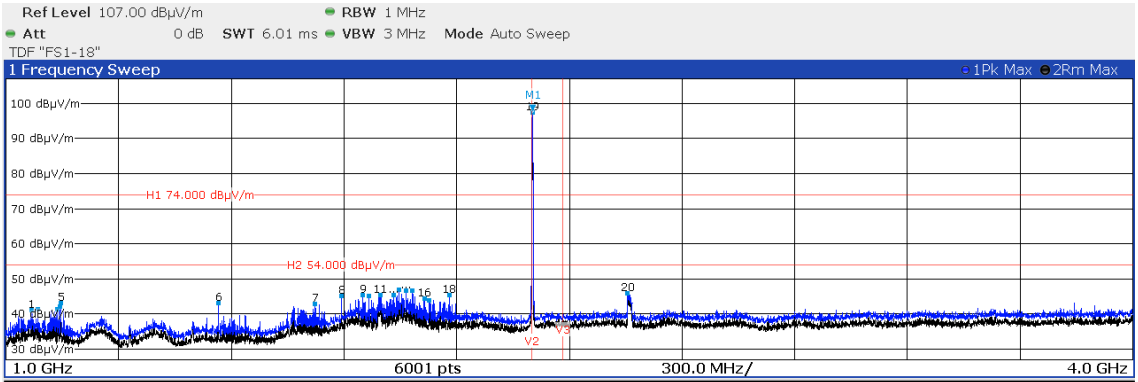


2 Marker Table

Type	Ref	Trc	X-Value	Y-Value	Function	Function Result
M1		1	2.479 725 GHz	96.81 dBµV/m		
M2		1	2.39 GHz	38.72 dBµV/m		
M3		1	2.4 GHz	39.14 dBµV/m		
M4		1	2.483 5 GHz	45.11 dBµV/m		

Emissions 1 GHz – 4 GHz:

CH37:



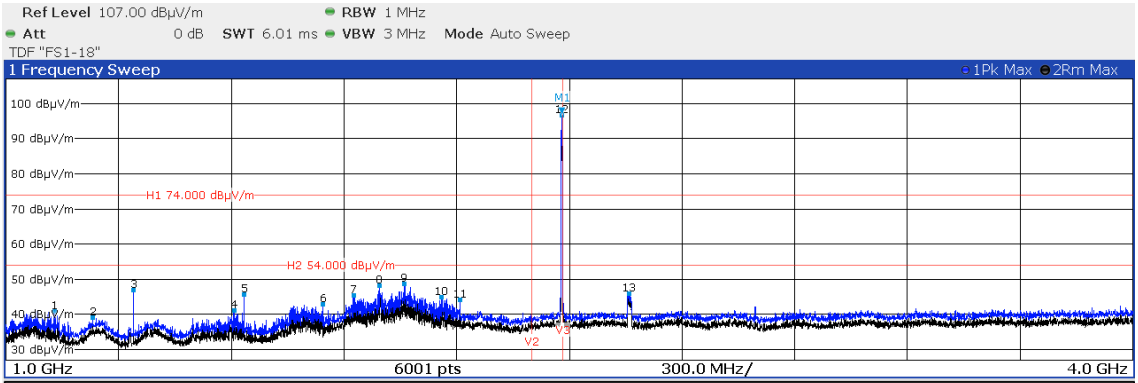
2 Marker Table

Type	Ref	Trc	X-Value	Y-Value	Function	Function Result
M1		1	**2.402 02 GHz**	**97.46 dBµV/m**		

3 Marker Peak List

No	X-Value	Y-Value	No	X-Value	Y-Value
1	1.069 240 GHz	41.035 dBµV/m	11	1.996 080 GHz	45.347 dBµV/m
2	1.085 740 GHz	41.299 dBµV/m	12	2.031 580 GHz	45.474 dBµV/m
3	1.135 730 GHz	41.489 dBµV/m	13	2.047 080 GHz	46.979 dBµV/m
4	1.142 730 GHz	42.143 dBµV/m	14	2.064 570 GHz	46.598 dBµV/m
5	1.146 230 GHz	43.271 dBµV/m	15	2.082 570 GHz	46.657 dBµV/m
6	1.565 660 GHz	43.258 dBµV/m	16	2.113 560 GHz	44.396 dBµV/m
7	1.822 610 GHz	43.002 dBµV/m	17	2.127 560 GHz	44.006 dBµV/m
8	1.893 600 GHz	45.269 dBµV/m	18	2.180 050 GHz	45.372 dBµV/m
9	1.950 590 GHz	45.533 dBµV/m	19	2.402 020 GHz	97.459 dBµV/m
10	1.966 090 GHz	45.134 dBµV/m	20	2.654 970 GHz	45.870 dBµV/m

CH39:



2 Marker Table

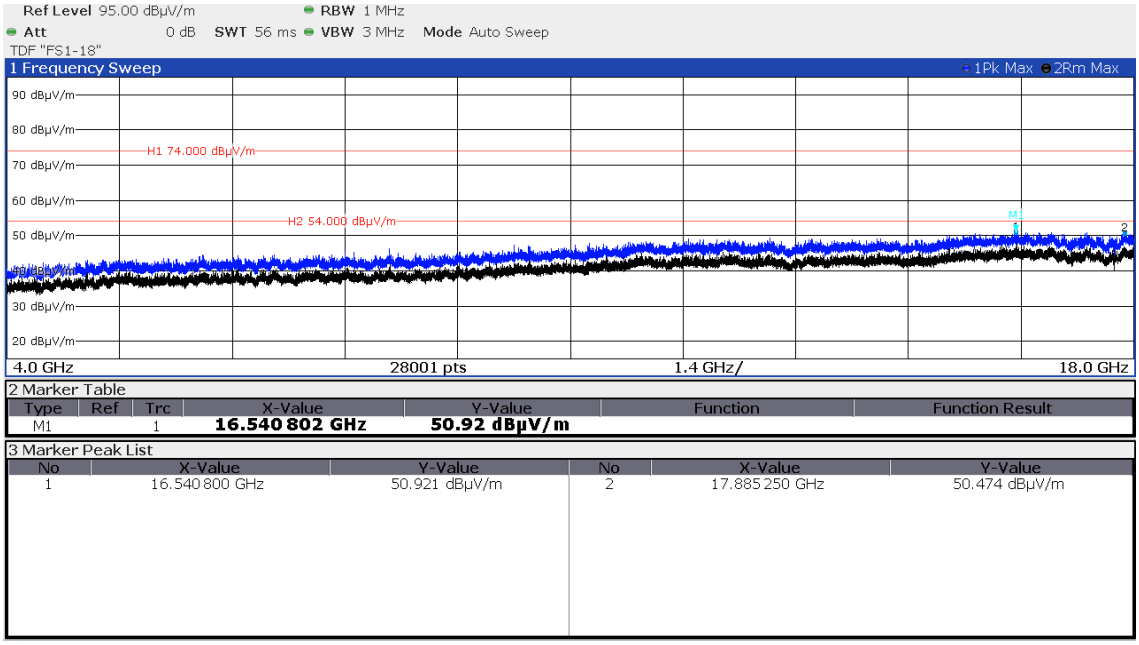
Type	Ref	Trc	X-Value	Y-Value	Function	Function Result
M1		1	**2.479 5 GHz**	**96.71 dBµV/m**		

3 Marker Peak List

No	X-Value	Y-Value	No	X-Value	Y-Value
1	1.129 230 GHz	40.961 dBµV/m	8	1.994 080 GHz	48.091 dBµV/m
2	1.231 210 GHz	39.105 dBµV/m	9	2.060 070 GHz	48.816 dBµV/m
3	1.340 190 GHz	46.837 dBµV/m	10	2.160 560 GHz	45.015 dBµV/m
4	1.608 150 GHz	41.168 dBµV/m	11	2.209 050 GHz	44.247 dBµV/m
5	1.634 640 GHz	45.571 dBµV/m	12	2.479 500 GHz	96.709 dBµV/m
6	1.844 610 GHz	42.779 dBµV/m	13	2.659 970 GHz	46.047 dBµV/m
7	1.925 100 GHz	45.464 dBµV/m			

Note: No emissions > 4 GHz could be identified with any channel setting.

Emissions 4 GHz – 18 GHz:



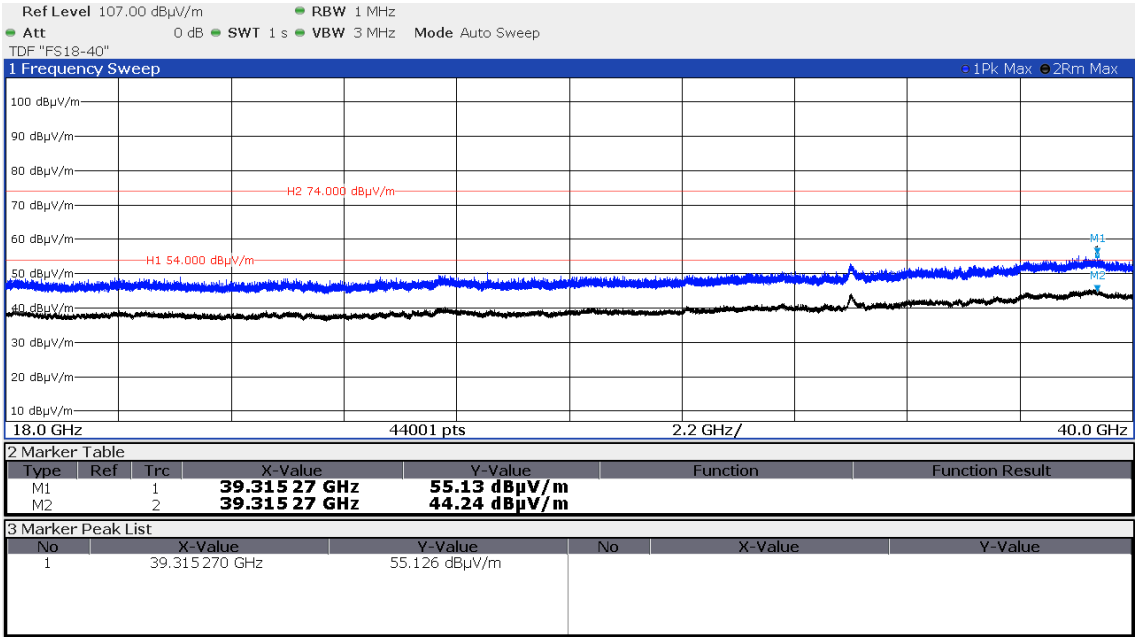
2 Marker Table

Type	Ref	Trc	X-Value	Y-Value	Function	Function Result
M1		1	**16.540 802 GHz**	**50.92 dBµV/m**		

3 Marker Peak List

No	X-Value	Y-Value	No	X-Value	Y-Value
1	16.540 800 GHz	50.921 dBµV/m	2	17.885 250 GHz	50.474 dBµV/m

Emissions 18 GHz – 40 GHz:



2 Marker Table

Type	Ref	Trc	X-Value	Y-Value	Function	Function Result
M1		1	**39.315 27 GHz**	**55.13 dBµV/m**		
M2		2	**39.315 27 GHz**	**44.24 dBµV/m**		

3 Marker Peak List

No	X-Value	Y-Value	No	X-Value	Y-Value
1	39.315 270 GHz	55.126 dBµV/m			

Radiated limits according to FCC Part 15 Section 15.209(a) for spurious emissions which fall in restricted bands:

Frequency	Field strength of spurious emissions		Measurement distance
(MHz)	(µV/m)	dB(µV/m)	(metres)
0.009-0.490	2400/F (kHz)		300
0.490-1.705	24000/F (kHz)		30
1.705-30	30	29.5	30
30-88	100	40	3
88-216	150	43.5	3
216-960	200	46	3
Above 960	500	54	3

Restricted bands of operation:

The field strength of emissions appearing within these frequency bands shall not exceed the limits shown in Section 15.209

MHz	MHz	MHz	GHz
0.090 – 0.110	16.42 – 16.423	399.9 – 410	4.5 – 5.15
0.495 – 0.505	16.69475 – 16.69525	608 – 614	5.35 – 5.46
2.1735 – 2.1905	16.80425 – 16.80475	960 – 1240	7.25 – 7.75
4.125 – 4.128	25.5 – 25.67	1300 – 1427	8.025 – 8.5
4.17725 – 4.17775	37.5 – 38.25	1435 – 1626.5	9.0 – 9.2
4.20725 – 4.20775	73 – 74.6	1645.5 – 1646.5	9.3 – 9.5
6.215 – 6.218	74.8 – 75.2	1660 – 1710	10.6 – 12.7
6.26775 – 6.26825	108 – 121.94	1718.8 – 1722.2	13.25 – 13.4
6.31175 – 6.31225	123 – 138	2200 – 2300	14.47 – 14.5
8.291 – 8.294	149.9 – 150.05	2310 – 2390	15.35 – 16.2
8.362 – 8.366	156.52475 – 156.52525	2483.5 – 2500	17.7 – 21.4
8.37625 – 8.38675	156.7 – 156.9	2690 – 2900	22.01 – 23.12
8.41425 – 8.41475	162.0125 – 167.17	3260 – 3267	23.6 – 24.0
12.29 – 12.293	167.72 – 173.2	3332 – 3339	31.2 – 31.8
12.51975 – 12.52025	240 – 285	3345.8 – 3358	36.43 – 36.5
12.57675 – 12.57725	322 – 335.4	3600 – 4400	Above 38.6

RSS-Gen, Table 6 – Restricted Frequency Bands

MHz	MHz	MHz	GHz
0.090 - 0.110	12.57675 - 12.57725	399.9 - 410	7.250 - 7.750
0.495 - 0.505	13.36 - 13.41	608 - 614	8.025 – 8.500
2.1735 - 2.1905	16.42 - 16.423	960 - 1427	9.0 - 9.2
3.020 - 3.026	16.69475 - 16.69525	1435 - 1626.5	9.3 - 9.5
4.125 - 4.128	16.80425 - 16.80475	1645.5 - 1646.5	10.6 - 12.7
4.17725 - 4.17775	25.5 - 25.67	1660 - 1710	13.25 - 13.4
4.20725 - 4.20775	37.5 - 38.25	1718.8 - 1722.2	14.47 - 14.5
5.677 - 5.683	73 - 74.6	2200 - 2300	15.35 - 16.2
6.215 - 6.218	74.8 - 75.2	2310 - 2390	17.7 - 21.4
6.26775 - 6.26825	108 – 138	2483.5 - 2500	22.01 - 23.12
6.31175 - 6.31225	149.9 - 150.05	2655 - 2900	23.6 - 24.0
8.291 - 8.294	156.52475 - 156.52525	3260 – 3267	31.2 - 31.8
8.362 - 8.366	156.7 - 156.9	3332 - 3339	36.43 - 36.5
8.37625 - 8.38675	162.0125 - 167.17	3345.8 - 3358	Above 38.6
8.41425 - 8.41475	167.72 - 173.2	3500 - 4400	
12.29 - 12.293	240 – 285	4500 - 5150	
12.51975 - 12.52025	322 - 335.4	5350 - 5460	

The requirements are **FULFILLED.**

Remarks: The measurement was performed up to the 10th harmonic. Only the worst-case plots are listed.

5.2 Antenna application

5.2.1 Applicable standard

According to FCC Part 15C, Section 15.203:
An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section. The manufacturer may design the unit that broken antennas can be replaced by the user, but the use of a standard antenna jack is prohibited.

The EUT has integrated PCB antennas. No other antennas can be used with the device.

All supplied antennas meet the requirements of part 15.203 and 15.204.

5.2.2 Antenna requirements

According to FCC Part 15C, Section 15.247(b)(4):
The conducted output power limit specified in paragraph (b) of 15.247 is based on the use of antennas with directional gains that do not exceed 6 dBi. Except as shown in paragraph (c) of this section, if transmitting antennas of directional gain greater than 6 dBi are used, the conducted output power from intentional radiator shall be reduced below the stated values in paragraph (b)(1), (b)(2) and (b)(3) of this section, as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

Defacto EIRP-Limit:

$$Pout = 30 – (Gx – 6);$$

The EUT use antennas smaller that 6 dBi. No defacto limit results.

Remarks: No power reduction results from the defacto limit.

6 USED TEST EQUIPMENT AND ACCESSORIES

All test instruments used are calibrated and verified regularly. The calibration history is available on request.

Test ID	Model Type	Equipment No.	Next Calib.	Last Calib.	Next Verif.	Last Verif.
A 4	BAT-EMC 3.21.0.24	01-02/68-13-001				
	ESCI	02-02/03-15-001	17/06/2023	17/06/2022		
	ESH 2 - Z 5	02-02/20-05-004	13/10/2025	13/10/2022	13/04/2023	13/10/2022
	N-4000-BNC	02-02/50-05-138				
	ESH 3 - Z 2	02-02/50-05-155	09/11/2025	09/11/2022	10/02/2023	10/08/2022
CPR 3	FSW43	02-02/11-15-001	22/04/2023	22/04/2022		
	AMF-6D-01002000-22-10P	02-02/17-15-004				
	3117	02-02/24-05-009	23/06/2023	23/06/2022		
	BAM 4.5-P	02-02/50-17-024				
	NCD	02-02/50-17-025				
	KK-SF106-2X11N-6,5M	02-02/50-18-016				
	BAT-EMC 3.21.0.24	02-02/68-13-001				
SER 2	ESVS 30	02-02/03-05-006	27/07/2023	27/07/2022		
	VULB 9168	02-02/24-05-005	20/12/2022	20/12/2021	03/07/2023	03/07/2022
	NW-2000-NB	02-02/50-05-113				
	KK-EF393/U-16N-21N20 m	02-02/50-12-018				
	KK-SD_7/8-2X21N-33,0M	02-02/50-15-028				
	50F-003 N 3 dB	02-02/50-21-010				
SER 3	FSW43	02-02/11-15-001	22/04/2023	22/04/2022		
	AMF-6D-01002000-22-10P	02-02/17-15-004				
	3117	02-02/24-05-009	23/06/2023	23/06/2022		
	BAM 4.5-P	02-02/50-17-024				
	NCD	02-02/50-17-025				
	KK-SF106-2X11N-6,5M	02-02/50-18-016				
	BAT-EMC 3.21.0.24	02-02/68-13-001				

-End of test report-